DOCUMENT RESUME

ED 113 193 SE 019 743

TITLE	Suggestions for Teaching Mathematics Using Laboratory Approaches Grades 1-6. 4. Measurement. Experimental Edition.
INSTITUTION	New York State Education Dept., Albany. Bureau of Elementary Curriculum Development.
SPONS AGENCY	Bureau of Elementary and Secondary Education (DHEW/OE), Washington, D.C. Div. of Compensatory Education.
PUB DATE	[74]
NOTE	52p.; Related documents are SE 019 740-742
EDRS PRICE	MF-$0.76 HC-$3.32 Plus Postage
DESCRIPTORS	Elementary Education; *Elementary School Mathematics; Guides; Instructional Materials; *Laboratory Manuals; *Manipulative Materials; Mathematics Materials; *Measurement; Teacher Developed Materials; *Teaching Guides
IDENTIFIERS	Elementary Secondary Education Act Title I; ESEA Title I

ABSTRACT

This guide describes activities and materials which can be used in a mathematics laboratory approach to a basic mathematics program for grades 1-6. One-hundred thirteen activities pertaining to measurement concepts are described in terms of purpose, suggested grade levels, materials needed, and procedures. Some specific concepts include: linear measurement (33 activities), area and volume (31 activities), weight measurement (31 activities), time measurement (18 activities), estimation, inequalities, equalities, graphing, comparisons, circumference, scale drawing, applications, similarity, non standard units, measure, counting, surface area, weight, density, indirect area measure, cost calculations, conservation, recording data, problem solving, time continuum, directionality, shadows and time relationships. Most activities utilize the English system of measurement, but many can be adapted to the metric system. The guide concludes with a list of selected manipulative materials for mathematics laboratory use. (JBW)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

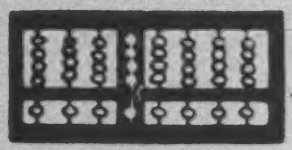
ED 113 193

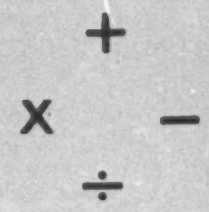
SUGGESTIONS FOR TEACHING MATHEMATICS USING LABORATORY APPROACHES

GRADES 1-6

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

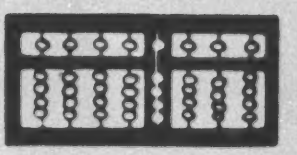
EXPERIMENTAL EDITION





3>1

5<6



4. MEASUREMENT

The University of the State of New York
THE STATE EDUCATION DEPARTMENT
Bureau of Elementary Curriculum Development
Albany, New York 12224

SE 019 743

THE UNIVERSITY OF THE STATE OF NEW YORK

Regents of the University (with years when terms expire)

1984	Joseph W. McGovern, A.B., J.D., L.H.D., LL.D., D.C.L. Chancellor	New York
1985	Everett J. Penny, B.C.S., D.C.S., Vice Chancellor	White Plains
1978	Alexander J. Allan, Jr., LL.D., Litt.D.	Troy
1987	Carl H. Pforzheimer, Jr., A.B., M.B.A., D.C.S., H.H.D.	Purchase
1975	Edward M.M. Warburg, B.S., L.H.D.	New York
1977	Joseph T. King, LL.B.	Queens
1974	Joseph C. Indelicato, M.D.	Brooklyn
1976	Mrs. Helen B. Power, A.B., Litt.D., L.H.D., LL.D.	Rochester
1979	Francis W. McGinley, B.S., J.D., LL.D.	Glens Falls
1986	Kenneth B. Clark, A.B., M.S., Ph.D., LL.D., L.H.D., D.Sc.	Hastings on Hudson
1983	Harold E. Newcomb, B.A.	Owego
1981	Theodore M. Black, A.B., Litt.D.	Sands Point
1988	Willard A. Genrich, LL.B., L.H.D.	Buffalo
1982	Emlyn I. Griffith, A.B., J.D.	Rome

President of the University and Commissioner of Education
Ewald B. Nyquist

Executive Deputy Commissioner of Education
Gordon M. Ambach

Deputy Commissioner for Elementary, Secondary, and Continuing Education
Thomas D. Sheldon

Associate Commissioner for Instructional Services
William L. Bitner III

Assistant Commissioner for Compensatory Education
Irving Ratchick

Director, Division of Education for the Disadvantaged
Louis J. Pasquini

Chief, Bureau of Education for the Disadvantaged (Upstate)
William C. Flannigan

Assistant Commissioner for Instructional Services (General Education)
Bernard F. Haake

Director, Division of General Education
Ted T. Grenda

Chief, Bureau of Mathematics Education
Frank S. Hawthorne

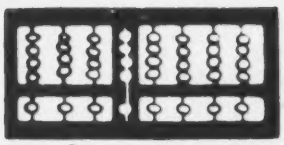
Director, Division of Curriculum Development
Gordon E. Van Hooft

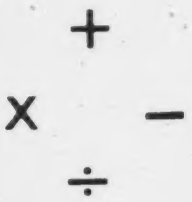
Chief, Bureau of Elementary Curriculum Development
Robert H. Johnstone

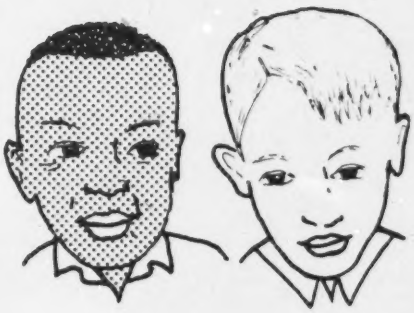
SUGGESTIONS FOR TEACHING MATHEMATICS USING LABORATORY APPROACHES

GRADES 1-6

EXPERIMENTAL EDITION

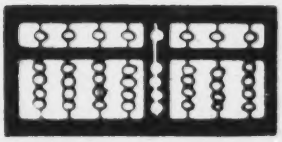






3>1

5<6



4. MEASUREMENT

The University of the State of New York
THE STATE EDUCATION DEPARTMENT
Bureau of Elementary Curriculum Development
Albany, New York 12224

PREFACE

Substantial financial aid to local educational agencies for children of low income families was provided by the Elementary and Secondary Education Act of 1965. Participating school districts have developed a variety of new educational programs to assist children with special educational needs. These programs are based upon local needs assessment with major parental involvement.

The three major priorities for compensatory education programs are bilingual education, reading, and mathematics. One of the highest priority programs under ESEA Title I is the subject matter area of mathematics. Experience has shown that children who have experienced difficulty learning in a traditional program often react with enthusiasm to a mathematics laboratory approach. This publication was developed to provide practical applications of this mathematics approach for use by classroom teachers. It should provide practical suggestions for teachers working directly with educationally disadvantaged children.

Irving Ratchick
Assistant Commissioner for
Compensatory Education

FOREWORD

The Bureau of Elementary Curriculum Development and Bureau of Mathematics Education in cooperation with the Division of Education for the Disadvantaged, ESEA Title I, have developed a variety of materials on the use of a Mathematics Laboratory approach on the elementary level. This joint effort has resulted in the release of two publications:

Teaching Elementary Mathematics Using Laboratory Approaches, which serves as a short introduction to the method

and

ESEA Title I, Anatomy of An Elementary Project, which gives a concrete example of the use of a Mathematics Laboratory approach with disadvantaged children.

Encouraged by the response of teachers and administrators to the original publications, a decision was made to move further in the direction of providing concrete activities for teachers who wished to move into the humanistic approach inherent in a Mathematics Laboratory program.

Fredric Paul of the Bureau of Mathematics Education and Peter A. Martin of the Bureau of Elementary Curriculum Development began the task of developing activities for teacher use. A committee of experienced teachers consisting of Claire Cohn, Helen Feder, and Pasquale Toscano, under the direction of Elaine Mintz was engaged as a writing team. Mrs. Mintz is director of elementary mathematics and the other three are teachers in the Plainedge School District. The material completed by this team was then sent out for field testing to 11 schools throughout the State for use with children. As a result of a favorable reaction on the part of the teachers who used this material, we have produced

experimental materials for use by school districts.

This publication is the last of four which are being developed for teacher use. Each will incorporate the latest thinking of the mathematics revision committee and may be utilized with any basic mathematics program. This publication is designed to serve as a stimulant to encourage teachers to open their minds and employ their imaginations in developing further activities. The classroom teacher in developing her own set of "task cards" will adjust vocabulary and choose concrete materials in terms of a close knowledge of the ability levels of her own children and the type and amount of manipulative materials available. Suggestions and reactions are welcome, and should be sent to Fredric Paul, Bureau of Mathematics Education, State Education Department, Albany, New York 12224.

Peter A. Martin of the Bureau of Elementary Curriculum, did the final editing and prepared the material for publication.

Robert H. Johnstone, Chief
Bureau of Elementary
Curriculum Development

Gordon E. Van Hooft, Director
Division of Curriculum Development

MEASUREMENT

LINEAR

4-1 Beginning Experiments. Purpose: Weight, measurement, capacity
Suggested Grade Level: 1, 2

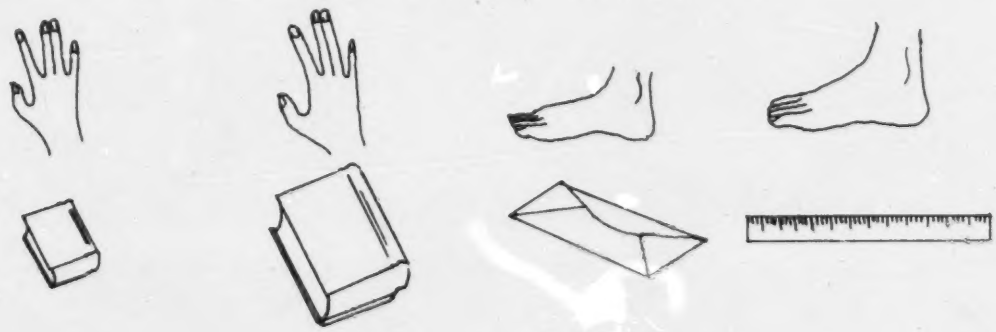
Materials needed: None

Procedure: General Introduction - Many activities in the primary grades involve comparing which leads to measuring-weighing volume. Therefore, comparing is one important objective. Vocabulary such as "smaller than", "how long", "bigger than", "heavier than", etc. is another. Concepts of conservation through many experiences is another. Either non-standard or un-marked standard units should emerge from children's experiences. Encourage children to use whatever devices they can to solve measuring problems in terms with which they are familiar. Personalized measures such as spans, paces and finger length can readily be used by each child. He can come to grips with sizes in his environment as they relate to himself. He should then be encouraged to record his findings in pictorial form.

4-2 Non-Standard Units. Purpose: Estimate, non-standard measuring, addition, equalities and inequalities, recording
Suggested Grade Level: 1, 2

Materials needed: None

Procedure: Find some things as long as your hand. Find some things as long as your foot. Find some things as long as your 2 hands. Find some things as long as your 2 feet. Draw them. Which is the longest? Which is the shortest? Make a book that has pictures of things that have the same measure as your foot length. Who has the biggest foot (hand) in the class? Who has the smallest? How did you find out?



4-3 Ribbons. Purpose: Counting, equalities and inequalities, sets, measurement

Suggested Grade Level: 1, 2

Materials needed: Ribbons of varying lengths

Procedure: Collect assorted ribbons for children to work with. Have them: Find ribbons which are the same (different) length. Find ribbons which are the same (different) width. Find ribbons which are the same (different) color. How many ribbons are shorter than you? How many ribbons are taller than you? Separate the ribbons into two heaps. Which heap has more ribbons? How can you find out? Is there a ribbon with the same measure as your waist? Your arm? Your wrist?

4-4 More Ribbons. Purpose: Counting, inequalities, measurement, graphing

Suggested Grade Level: 1, 2

Materials needed: Ribbon, cord or string

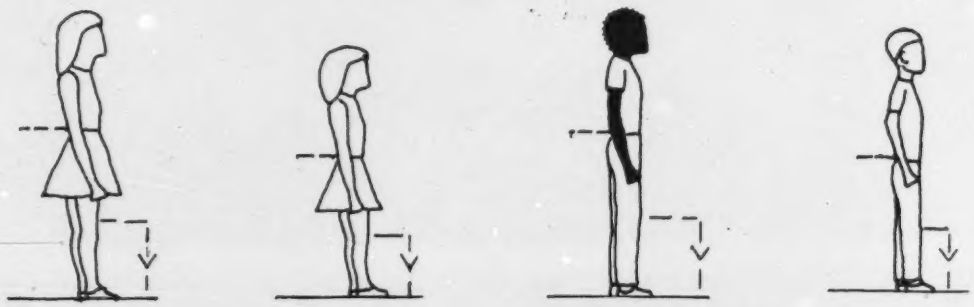
Procedure: Take paper ribbon or cord. Cut off enough to go around your waist. Make a name tag and paste your ribbon on it. Who has the longest ribbon? Who has the next longest ribbon? Etc. Who has the shortest? Who has the biggest waist? Who has the smallest waist? How many are there altogether? Make a chart by pasting the ribbons side by side, in order, from the smallest to the biggest.

4-5 Guessing Game. Purpose: Equalities and inequalities, linear measure, personalized measures

Suggested Grade Level: 1, 2

Materials needed: String

Procedure: Which is longer? Distance from the top of your knee to the floor or the distance around your waist? Find your answer without using a tape measure or ruler. How does your answer compare with your friend's?



4-6 Math Lab on the Playground. Purpose: Linear measure, equalities and inequalities, counting

Suggested Grade Level: 1, 2

Materials needed: cord or string, scissors, playground equipment

Procedure: Hold one end of a cord at the top of the monkey bars. Ask your friend to cut the cord where it reaches the ground. Stretch the cord straight along the ground. Follow the same procedure from the top of the slide and the see-saw. Which is highest, the monkey bars, the slide, or the see-saw? How many of you could fit (head to toe) as high as the monkey bars? the slide? How many of your friends could fit? With the help of a friend take some string and stretch it from one end of the slide to the other along the sloping part. Stretch it from the top of the ladder to the bottom. Stretch it from step to step. How many steps are there? Compare the number of spaces between steps to the height of the ladder. Draw what you see. What did you find out?

4-7 We're the Greatest. Purpose: larger than, smaller than, equalities, inequalities, pictorial representation, pupil-created measurements, graphing, intuitive area, measure

Suggested Grade Level: 1, 2

Materials needed: 1/2" x 1/2" or 1" x 1" graph paper

Procedure: Collect patterns of children's hands, feet, body outlines drawn on graph paper. Compare sizes of the patterns, which are each labeled with the owner's name. Use patterns for measuring objects inside and outside the classroom. Attractive displays can be made with these pattern silhouettes representing each child in the class. They may be arranged in order of size, alphabetically, like a map, etc.

4-8 Each in his Own Place. Purpose: Graphing, comparisons, measurement, inequalities, numberline, 1:1 correspondence

Suggested Grade Level: 1, 2

Materials needed: Wrapping paper, scissors, tacks or tape

Procedure: Have the pupils arrange themselves in size order. Decide who is tallest, shortest, etc. Have each child lie on a sheet of paper. Trace an outline of each child on the paper. Cut out the silhouettes. Let each child print his name on his silhouette. Tape or tack them up around the room or in the hall in order of size. Does the order of the silhouettes agree with the decisions observed before? Number the silhouettes in order for a personalized class numberline and graphic representation. Note the correspondence between the children and their cutout forms.

4-9 Back and Forth. Purpose: Directionality, comparison, measurement, conservation

Suggested Grade Level: 1, 2

Materials needed: Cord or string, scissors

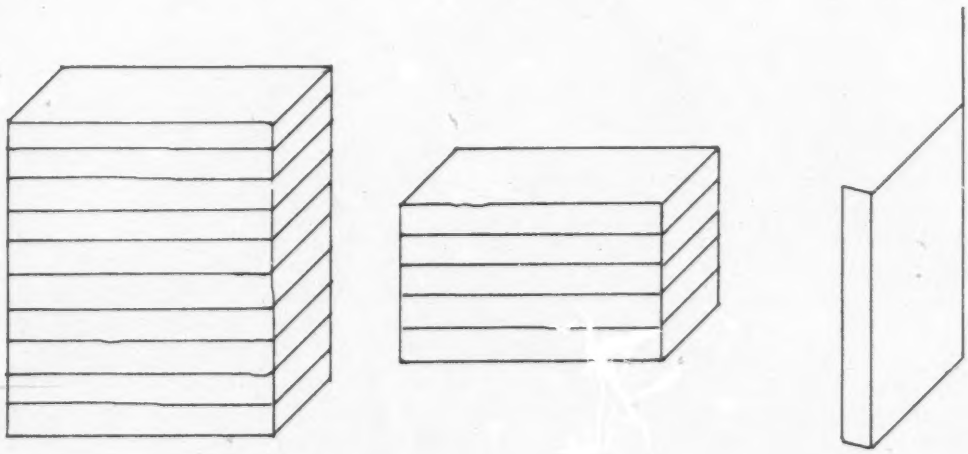
Procedure: With the help of a friend, cut a piece of string that goes from the top of your desk to the floor. Now, cut one that goes from the floor to the top of your desk. Compare the two strings. Are they the same or different? Measure your desk top (with string) from right to left. Now measure it from left to right. How do the distances compare? Why?

4-10 Measurement. Purpose: Counting, adding, multiply, fractions, comparing, measuring

Suggested Grade Level: 1, 2

Materials needed: Rectangular building blocks, string

Procedure: Make a wall 10 blocks high. Measure it with a piece of string. If you put the same blocks together using a different side as base, guess how many blocks you will need for wall as high as you made before. How can you discover how many you need? Do it and check your guess. Next to the 10 block wall, make a wall with 5 blocks high. What do you notice? Anticipate expressions of inequality, one wall is twice as big (half as 'ig) as the other, etc. Try this experiment varying the number of blocks and their sizes.



4-11 "Measure With Your Span". Purpose: Non-standardized measurement, comparisons, counting

Suggested Grade Level: 1, 2

Materials needed: None

Procedure: Stretch your fingers so wide that your little finger and your thumb are as far apart as you are able to get them. We call the distance from the tip of your finger to the tip of your thumb your SPAN. Find some things in your room to measure with your span. The teacher may write down lists for children. First guess how many spans an object might take. Record guess. Measure spans. Record spans. Compare guess to actual measure. Compare your measures with your neighbors; with your teacher.

4-12 Foot Prints. Purpose: Directionality, counting, comparisons correspondence, measurement, graphing number lines

Suggested Grade Level: 1, 2

Materials needed: Paper, pencil, string, scissors

Procedure: Let's work in groups of (depending on size of class). Remove your shoes. Stand on a piece of paper. Ask a friend to draw around your feet. You do the same for him. Label your right and left foot patterns. Print your name on your patterns. Cut out the shape of each foot. Put the feet patterns in a straight row. How many feet are in your group? How long is the line of feet? Use string to measure your groups' line. Compare with other groups. What do you see?
NOTE: Patterns may be made on graph paper. They may be posted along the walls of the room. They may be numbered and used as number lines.

4-13 "Pacing". Purpose: Counting, estimation, non-standard measure, tallying, comparisons, recording

Suggested Grade Level: 1 - 3

Materials Needed: Tally counter

Procedure: Discuss pacing. Have children estimate their paced dimensions of the classroom, lunchroom, corridors, playground, etc. Have children working in pairs, actually pace these distances. They may keep track of their steps by tallying. Record the results. Compare the estimates with the actual counts. Compare the counts found by different children.

4-14 Accuracy. Purpose: Greater reliability in measurement
Suggested Grade Level: 1, 2

Materials needed: Trundle wheel, yardstick, tally counter

Procedure: Discuss the varied data gathered from use of non-standard body measures. Elicit need for standard measures. Introduce Trundle wheel or yardstick and assign groups of pupils to remeasure dimensions of areas previously paced off. Record the new data and compare it with the old.

4-15 How Long? Purpose: Equalities, and Inequalities
Suggested Grade Level: 1, 2

Materials needed: Common things found in the classroom

Procedure: Which is longer? A straw or a toothpick? Your reader or your pencil? A new crayons or a paintbrush? Draw the longer things. Compare with the class.

4-16 Primary Ruler. Purpose: Equalities and Inequalities
Suggested Grade Level: 1, 2

Materials needed: Primary ruler

Procedure: Make a ruler and see how many things you can find that are longer than the ruler; Shorter than the ruler; The same size as the ruler.

4-17 "What Is Round"? Purpose: Circular measurement, shapes, counting, ordinal numbers, recording
Suggested Grade Level: 1, 2

Materials needed: common round objects, string

Procedure: Ask children to bring in round things from home. What round things can we find in the classroom? How can we measure them? Find out about how long it is around each one. Arrange them according to size. Largest first, etc. Count them. Draw them.

4-18 "Finger Findings". Purpose: Non-standardized measuring devices, estimation

Suggested Grade Level: 3, 4

Materials needed: "Junk", classroom facilities

Procedure: Using a finger width, children can measure many things. Allow the children to decide what items would be suitable. Individual children can prepare chart as follows:

Object	My Guess	Finger Widths	Right or Wrong
Book Pencil box Etc.			

4-19 Spanning the World. Purpose: Estimation, non-standardized measuring devices

Suggested Grade Level: 3, 4

Materials needed: None

Procedure: Have each child find his hand span. (Stretch fingers as wide as possible - distance between tip of thumb and tip of little finger is called the span). Individual children can make chart as below. Let them think of many distances to measure.

Object	My Guess	Number of Spans	Right or Wrong
Width of desk Width of window Width of door Length of table			

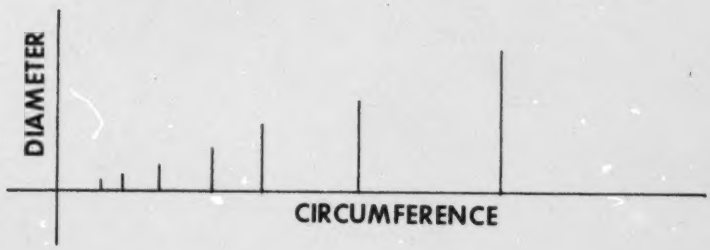
Compare results obtained by several members of the class.

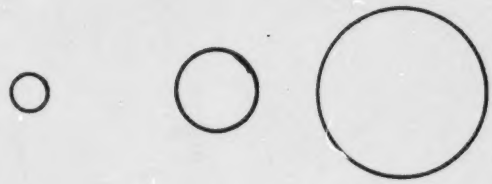
4-20 Roly-Poly. Purpose: Measurement, circumference and diameter, graphing, functional relationships

Suggested Grade Level: 3-5

Materials needed: String, scissors, round objects of different sizes

Procedure: Children use string, measure and record circumference and diameter of round objects. (Use at least 6). Prepare graph to show results. What do you notice?





If the round object is rolled one complete turn along the horizontal axis, the circumference may be marked directly. The string for the diameter can be placed on the graph.

4-21 Paceways. Purpose: Measurement, length, unit conversions

Suggested Grade Level: 3, 4

Materials needed: Rulers, Tally counters

Procedure: Have pairs of children measure classroom, hallway, playground, etc. by pacing. Convert to feet, inches, or to metric measure.

4-22 Contacts - Far and Near. Purpose: Measuring on a map or globe multiplication, whole numbers

Suggested Grade Level: 3, 4

Materials needed: Collect letters and postcards from many places, large world map, map measure or string

Procedure: Prepare bulletin board with the world map in the center. Scatter cards on bulletin board. Have children locate point of origin and attach string or yarn from that point to card or letter. Using map measure or string, children can determine distance the letter traveled.

4-23 Stringing Along. Purpose: Linear measurement, addition, subtraction, fractions, odd and even numbers

Suggested Grade Level: 3-5

Materials needed: String, ruler, scissors

Procedure: Cut a piece of string two inches long. Use this 2 inch string to mark off a 3 inch line segment. Use it to mark off a 4-inch segment. Continue in same manner to mark off many different sized lengths. Discuss other ways of accomplishing the task.

4-24 So Big #1. Purpose: Linear measure, estimation, fractions

Suggested Grade Level: 3-6

Materials needed: 12 inch ruler

Procedure: Prepare chart as follows:

Item	Estimate	Actual Measurement
Book		
Shoe		
Pencil		
Pen		

(Have students select other items suitable for measurement with 12 inch ruler)

4-25 So Big #2. Purpose: Linear measurement; estimation, addition, facility with standard measuring tools, fractions, unit conversions

Suggested Grade Level: 3-6

Materials needed: Yardstick, meter stick, Trundle Wheel

Procedure: Prepare chart as follows:

Item	Estimate	Actual Measurement
Door		
Room		
Width of hall		
Length of hall		

Have students select other items suitable for measurement with yardstick, meter stick, or trundle wheel. What other instruments could be used for these tasks?

4-26 "Geometry Outdoors". Purpose: Linear Measure, scale drawings

Suggested Grade Level: 4 - 6

Materials needed: Tape measure, Trundle Wheel, Bicycle, Graph paper

Procedure: Make maps of the playground, outside of the school, library, your home.

4-27 Roller Ramp. Purpose: Application of mathematics to science problems (involving work and energy). Linear measure. Averages

Suggested Grade Level: 5, 6

Materials needed: Inclined plane (Folded cardboard trough or wooden board propped up at one end), marble or small ball, ruler, timer

Procedure: Pupils can conduct experiments where they govern the fixed and variable factors. As a basic problem, have them consider: Set a block at the end of a ramp. Roll a spherical object down a ramp. See how far the block is pushed by the spherical object. Measuring the time and distance of the operation. Variations: Vary the weight, shape and material of the moving objects, use wind-up toys. Change the length, slope and material of the ramp. Repeat the experiment without variations and average the results obtained.

4-28 X Marks the Spot. Purpose: Measurement-Linear, shadows and heights, patterns

Suggested Grade Level: 3, 4

Materials needed: Several sticks of different lengths, tape measure

Procedure: On a clear, sunny day, have children work in pairs outdoors. Mark a spot. Have one pupil hold stick perpendicular to the ground at the mark. The other pupil measures the stick's shadow. Have each child stand at the mark while his partner measures his shadow.

Record:

Length of stick				
Length of shadow				
Height of child				
Length of shadow				

Put this information on a graph.

The children, after calculations and discussion of the results, should see that by measuring the shadow they can calculate the height of any object.

4-29 "Shadowy Shapes". Purpose: Similarity, number pattern, ratios
Suggested Grade Level: 4- 6

Materials needed: 2 dimensional shapes, square, circle, triangle, polygons, irregular shapes, children's silhouettes

Procedure: Have pupils work in threes - one using a flashlight, one to hold the shape being used, one to measure and record data. (Shadows grow according to a square number pattern.) Hold a square tile one foot from a wall. Shine a light on it so that it casts a shadow on the wall. What shape is the shadow? Measure it. Repeat the experiment holding the tile two and then three feet from the wall. Will the wall be big enough to hold the shadow when the tile is held 10 feet away? Conduct similar experiments with other shapes.

4-30 "The Sky's The Limit". Purpose: Linear measure, patterns, ratio and proportion, similar triangles, scale models
Suggested Grade Level: 5, 6

Materials needed: Tape measure, rulers, paper, clinometer*, string

Procedure: On a sunny day, find the height of a building. Next, find the length of the building's shadow, your height and the length of your shadow. Use triangles as models for your data.

Compare your friends' results with yours. What pattern can you find that can help you figure the height of other objects. (trees, flagpole)

4-31 "Linear Measure". Purpose: Linear measures, inequalities, graphing
Suggested Grade Level: 5, 6

Materials needed: Non-standardized measuring devices

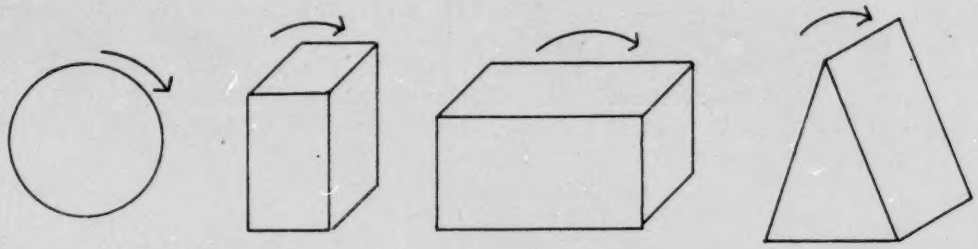
Procedure: Have students working in pairs use non-standardized materials for gauges -
Ex: Body parts, eraser, pencil, etc. Before each measurement, estimates should be made. Find perimeter of your desk top, chair seat, blackboard, teacher's desk, classroom door, etc. Have pupils record their results using various graphing techniques. Discuss the positive aspects and the shortcomings of the approach used.
Note: 12 John's pencils = 14 Mary's span = 10 Tom's span, etc.

4-32 Roundabout #1. Purpose: Finding circumference or perimeter

Suggested Grade Level: '5, 6

Materials needed: 3-D Solids

Procedure: Have children collect a set of objects and find their circumferences by rolling or tumbling them along a straight line for one complete turn. How else could the circumference be measured? How could a bicycle be used to find the perimeter of the playground?



4-33 Roundabout #2. Purpose: Linear measure and circumference, whole number and fraction operations, ratio, circular parts, circle area, data analysis, function rules

Suggested Grade Level: 5, 6

Materials needed: Ceiling tiles or cork board, compass, graph paper, pins, string

Procedure: Have students use compasses to draw a set of at least six different sized circles on graph paper (center on Lattice point). Cut out circle. 1) Pin the paper circle securely onto ceiling tiles or cork board; 2) Lay string along the circumference; 3) Draw a line segment the same length as the string; 4) Use string to measure through middle of circle (diameter). Draw this length below the other; 5) Which segment is longer? 6) How does the smaller segment compare with the larger? 7) Repeat steps 1-6 with the remaining circles. Make a record of your findings; 8) Organize data observed with the circles on a chart. What patterns can you find?

Circle #	Radius	Diameter	Circum-ference	# Graph Boxes In Interior	# Graph Boxes Along Circumference

AREA - VOLUME CAPACITY

4-34 Containers. Purpose: Introduction to attributes of 3-D containers and volume concepts, sets
Suggested Grade Level: 1, 2

Materials needed: Assorted containers, filling "junk"

Procedure: 1) Ask pupils to bring in empty containers from food, clothing, equipment. 2) Discuss containers - variations in shapes, size, material, weight, durability, purpose. 3) Have pupils sort the containers into sets according to the attributes discussed.

4-35 Filling Containers. Purpose: Non-standard units, estimation, recording, counting, comparisons, tallying
Suggested Grade Level: 1, 2

Materials needed: Cup, large container, filling "junk"

Procedure: Have children work in pairs. Choose a large container and a cup. Fill the cup. Empty the cup into the large container. About how many full cups do you think will fill the large container? Guess! Record it. Now fill the large one with the cup and count how many cupsful. Record it. Make tally marks 𝍸 as you count. Compare your guess with your count. Repeat the above with different filling materials.

4-36 "What's Inside?" Purpose: Estimation, volume recording, ordinal numbers, counting
Suggested Grade Level: 1, 2

Materials needed: Assorted containers, scales, filling "junk"

Procedure: Provide an assortment of containers. Have pupils arrange them in the order that they estimate will hold the least to the most. The estimated order should be recorded pictorially or verbally. (The baby jar, the vase, the milk container...)
Challenge: How can you find out if your guess was correct? Note: A more refined approach to this experiment can be used after children have experience using various filling "junk". Transparent containers and colored water can give improved estimates and provide better visual perception.

4-37 Spoons and Cups. Purpose: Measuring, volume, estimate, recording

Suggested Grade Level: 1, 2

Materials needed: Tablespoon, cup, milk container, pail, water, sand

Procedure: You may use spoons for measuring. Use the spoon to fill a cup with water (sand). Use a cup to fill a pail with water (sand). Use a small milk container to fill a large milk container with water. How many spoons of water filled the cup? How many spoons of sand filled the cup? How many cups of water filled the pail? How many cups of sand filled the pail?, etc. What did you find out?

4-38 "Teaspoons and Tablespoons". Purpose: Volume, counting, recording

Suggested Grade Level: 1, 2

Materials needed: Teaspooon, tablespoon, sand, rice, sugar, flour, water

Procedure: Use a teaspoon to fill a tablespoon. 1) fill it with sand; 2) fill it with sugar; 3) fill it with flour; 4) fill it with rice; 5) fill it with water. How many teaspoons of each material did you need to fill the tablespoon? Draw a picture of what you did.

4-39 Juice. Purpose: Relationships, measuring, counting, recording, order

Suggested Grade Level: 1, 2

Materials needed: Filling junk, cans

Procedure: Collect tin and aluminum cans. Arrange them according to size (estimated). Use a frozen juice can as your measure to fill the other cans. How many filled juice cans does each of the other cans hold?

4-40 Filling Station. Purpose: Volume, counting, measuring, recording

Suggested Grade Level: 1, 2

Materials needed: 1 small and 1 large cup, variety of filling materials

Procedure: Use a small cup to fill a big one. Do this experiment many times, using a different filler each time, such as beads, beans, pebbles, blocks, rice, water. How many of the little cups fill the big one? Was it the same or different for each experiment? Which filler do you think is best to use? Why?

4-41 Bottles and Cups. Purpose: Volume, estimate, measuring, counting, recording, inequalities

Suggested Grade Level: 1, 2

Materials needed: Basin, plastic bottle, cup, bucket

Procedure: A. Fill a plastic bottle with water. Place a cup in a basin. Carefully empty the water from the bottle into the cup. How many cups of water were in the bottle? B. Fill a bucket with water. Will it take more or fewer cups to empty the bucket? Use the same cup to find out. Draw results.

4-42 Water in Aquarium. Purpose: Estimation, volume, measure counting, linear measure, graphing

Suggested Grade Level: 1, 2

Materials needed: Aquarium, water, ruler, assorted containers

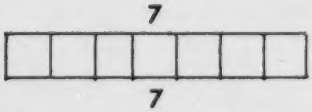
Procedure: Estimate how many containers (your choice) of water the aquarium holds. Fill it and find out. How close was your guess? Keep record of the height of the water in the aquarium each day. Why does it change?

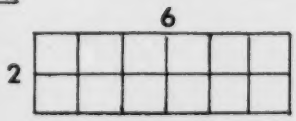
4-43 Corraling Cubes. Purpose: Measurement - constant perimeter and varying areas

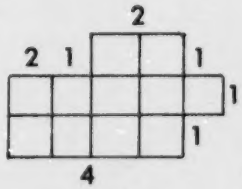
Suggested Grade Level: 3-6

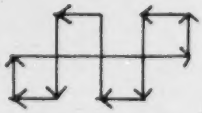
Materials needed: Graph paper, string, one inch cubical blocks

Procedure: Place blocks so that at least 1 edge of each block meets an edge of another block. Cut a piece of string 16" long. Use the string like a fence around the blocks. On the graph paper draw diagrams of the way you corraled the cubes with the string. What was the largest number of blocks you used? the smallest?









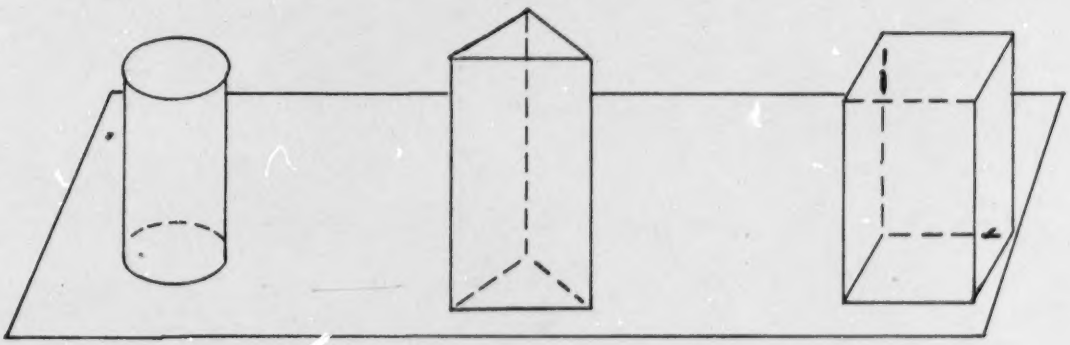
IS THIS LEGAL?

4-44 Tubby Tubes. Purpose: Measurement - constant surface area and varying volume

Suggested Grade Level: 3-6

Materials needed: Construction paper

Procedure: Children cut five rectangular pieces of paper 6 inches by 4 inches. Roll or fold each rectangle and tape the vertical edges to form tubes with 0, 3, 4, 5, or 6 vertical edges. Affix tubes to a base.



Estimate which tube will hold most, second most, etc. Using dry materials, (pellets, sand, rice, etc.) fill the containers. Now check with estimates. What general statement can you make? (The more nearly circular, the more the tube will hold). Why is this so?

4-45 Outsiders. Purpose: Surface area, estimation, subtraction

Suggested Grade Level: 3-5

Materials needed: Set of Geo-Blocks

Procedure: Select a block. How much "outside" does it have? How can you measure the outside? Trace each side of the block on a piece of paper and cut them out. Can you tape the pieces together so they can be folded to make a paper block? Can you draw a shape which, when folded, will make a paper block? Can you arrange some blocks in order of total surface area? from smallest to largest? Guess what the area is. Then check. How close was your guess?

4-46 Surfaces. Purpose: Measurement - area

Suggested Grade Level: 4 - 6

Materials needed: Colored squares and triangles

Procedure: Decide on unit of area. Now calculate area of different pieces. Choose another unit and repeat.

4-47 "Whatzit". Purpose: Finding area

Suggested Grade Level: 3, 4

Materials needed: Packet of squares, triangles, rectangles made of colored, gummed paper, Parquetry or Tesselation sets

Procedure: Encourage free rein for the imagination. Using the shapes, what can you make? A bird? A ship? A plane? etc. Decide on unit of area. What is the area of the figure you made?

4-48 The Scope of the Scoops. Purpose: Finding area, multiplication, whole numbers

Suggested Grade Level: 3, 4

Materials needed: Newspapers and magazines

Procedure: Children find area of one page. Using this information they can find total area of newspaper or magazine.

4-49 Block Boxing. Purpose: Measurement, volume, congruence, fractional parts

Suggested Grade Level: 3 - 5

Materials needed: Set of Geo-Blocks

Procedure: 1) Pick any large block and any small block. Find out whether a set of the small blocks can be fitted to a shape congruent to the larger one. Is there any space left over? How many small blocks were used? 2) Pick another large block. How many different ways can you make a congruent block using smaller ones? Try it with small ones all the same shape. Now try it with different shapes. Which way is better? 3) Find a small box. Can you fill it with one kind of block? How many will fit? Try it with different blocks.

4-50 Packing Business. Purpose: Liquid measure, volume

Suggested Grade Level: 3, 4

Materials needed: Standard measuring beakers or quart, pint, etc., food containers

Procedure: Using the containers find out: How many quarts in a gallon? How many pints in a gallon? How many pints in a quart? Experiment with assorted fillers - beans, rice, beads, cubes, counters, sand, water, to determine best material. Pupils may use balance scales with this project. List items which are sold by the half pint, pint, quart and gallon.

4-51 Models. Purpose: Subtraction, linear measure, weight, factions; ratio scales, area; volume, density

Suggested Grade Level: 3- 6

Materials needed: Clay, plasticene, paper mache, cardboard, paper, pipe cleaners, fabric, styrofoam, geoboards, geoblocks, geostrips

Procedure: A. Make a large model of a small object. How can you compare their sizes?

B. Make a small model of a huge object. How can you compare their sizes?

4-52 Rearrangement. Purpose: Measurement - constant volume, varying surface, tabulation of data

Suggested Grade Level: 3, 4

Materials needed: Box of one inch cubes

Procedure: Using 12 cubes each time make as many different rectangular solids as you can. Each time record the measurements of your building:

Experiment #	Length	Width	Depth
1	1	1	12
2	1.	2.	6.
3.	.	.	.
.	.	.	.
.			

How many different buildings can you make with the 12 blocks? How many could you make with 16 blocks? What have you observed?

4-53 On the Level. Purpose: Measurement - capacity, displacement of water, Data analysis, scale construction

Suggested Grade Level: 3 - 5

Materials needed: Glass jar, plasticene, cubic inch measure

Procedure: Past a strip of paper vertically on the jar. Be sure the jar is on a flat surface. Use the cubic inch measure to pour one cubic inch of water into the jar. Mark the water level on the paper each time you add water. Now empty some of the water but be sure that what is left is an exact number of cubic inches. Drop an inch cube of plasticene into the water. Check the water level - what happened? Now use 2 cubic inches of plasticene, then 3. Can you make a generalization?

4-54 The Big Build-Up. Purpose: Measurement - volume, multiplication, data tabulation

Suggested Grade Level; 3 - 5

Materials needed: Box of one inch cubes

Procedure: Form a square base with four cubes. Build up square layers on top of the base, keep track of the cubes you use in a table.

# Layers	Cubes in each layer	Total # 1 inch cubes used	Volume
1	4	4	
2	4	8	
3	4		

What do you notice about the volume? Repeat the experiment with other square bases. Try the experiment with rectangular bases.

4-55 Find the Pattern. Purpose: Measurement-volume
Suggested Grade Level: 3, 4

Materials needed: Box of one inch cubes

Procedure: Using the cubes children build different solids. Count the blocks to find the volume. Record as follows: The block is ___ cubes wide, ___ cubes long and ___ cubes deep. Some children will derive the formula on their own. l x w x d = volume, (for rectangular solids).

4-56 Six Pack Variations. Purpose: Measurement, capacity, volume
Suggested Grade Level: 3, 4

Materials needed: Six glass jars of different size

Procedure: Label the jars - A, B, C, D, E, F. Estimate and record - which holds the most, next and so on. Now measure the actual capacity of each and record your answers. Were you correct on your estimates?

4-57 "Two-Cents Plain". Purpose: Measurement, units, cost calculations
Suggested Grade Level: 3- 6

Materials needed: Brochure from supermarket, restaurant menu

Procedure: Find out how much a bottle of soda costs. Can you figure out how much a glass of soda should cost? How much does a glass of soda cost in a restaurant? Why does it cost more in a restaurant than at the supermarket? Students should ask: "How much in a "bottle? How much in a glass?"

4-58 "Holding Power". Purpose: Division, volume
Suggested Grade Level: 6

Materials needed: Sage Kit, Ideal volume, Relationship set, funnel, assorted blocks, beads, paper clips, junk, dry, granular material - raw rice, sawdust, sand, water, clay

Procedure: Have students consider the materials they can use best to fill various hollowed, 3-D geometric shape - cubes, cylinder, triangular, prism, cone, triangular and square pyramids, hemisphere, etc. a) Estimate: How much material will each solid hold? Which will hold the most? the least? the same amount? b) Arrange the solids in size place according to the estimate. c) Compare the volumes using different fillers. d) Compare the calculated volumes with the estimates.

4-59 "Sand Shapes". Purpose: Volume, whole number and fraction operations

Suggested Grade Level: 6

Materials needed: Ideal Volume, Relationship Set, sand, sage kit

Procedure: Have student "play" with sand, hollowed plastic cylinder, cone, and pyramid. 1) Guess how many cone scoops of sand fill the cylinder and the pyramid. Find out. 2) How do the volumes of the three shapes compare with each other? What other measurements can you compare on them? 3) In what way are the figures alike? In what way are the figures different?

Attribute	Pyramid	Cylinder	Cone
Shape of base			
# edges			
etc.			

4-60 "Personalized measurements and the environment ". Purpose: Weight-area relations, ratio, division, graphing

Suggested Grade Level: 5, 6

Materials needed: Tape measure, scale, graph paper

Procedure: Gather data for each member of the class. Arrange it graphically to show patterns. How many pounds of your weight does each square inch of your feet support? (The average person has a weight/sole ratio of about 2 pounds per square inch). How many pounds of air does each square inch of your body support. (Air pressure at sea level is about 14.7 lb. per square inch). Can you get similar data for your pets?

4-61 "Our Four Walls". Purpose: Indirect Area measure, whole number and fractional operations

Suggested Grade Level: 5, 6

Materials needed: Non-standard measures to be found in the classroom as string, window pole, book, child, chair height, floor tiles, etc. Measuring tools: yardstick, trundle wheel, tape measure, meter stick, clinometer, gradient measure

Procedure: Have a group of 2 or 3 students work together to find the area of the walls in the classroom. They may not use a ladder or climb on any furniture. Consider the composition of the wall - cinder blocks, window panes, doors, mouldings, chalk board, etc. More advanced students should take into account, base moulding and mortar joints. Research: How much paint is needed to cover the classroom walls? All classroom walls in the building? How much would such a project cost?

4-62 "Rolling out the red carpet ". Purpose: Whole number and fraction operations, percentage, area, volume, cost calculations, geometric shapes, ratio and proportion

Suggested Grade Level: 5, 6

Materials needed: Mail order department store catalog (calculators)

Procedure: Give students the problem of re-covering classroom floor. 1) Determine an allotment of money based on current prices. 2) Have them choose the materials from a catalog. (Be sure to include tools and adhesives) 3) Have them figure the cost of wall to wall commercial carpet, tiles of vinyl, vinyl asbestos, asphalt, cork Include sales tax calculations. 4) Have pupils make designs for tiling. 5) Make a miniature model of the new floor. After the classroom room dimensions have been found, ask how much of the room (average) each person has to himself. Questions relating floor space, air space and appropriate measurement units should be investigated. Percentage values may be applied.

4-63 Geoboard - Area #1. Purpose: Area, geometric shapes, relationships, fractions, units of measure

Suggested Grade Level: 5, 6

Materials needed: Geo-Boards, rubber bands

Procedure: Let's agree that the smallest square you can make on the geoboard is the unit of area. Make a 3-sided figure on the geoboard and find its area. Do the same with 4, 5, 6 sided figures. Construct a figure and ask a friend to find its area. Make up your own unit of area. Construct some figures and find their areas using your own unit. Can you make a figure with an area of 2 square units? 4, 5, 6, 9, 11? How about 1/2 square unit?

4-64 Geoboard - Area #2. Purpose: Fractions, geometric shapes, area

Suggested Grade Level: 5, 6

Materials needed: Geoboard, rubber bands

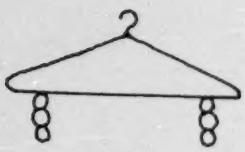
Procedure: 1) Make all the different triangles you can which have an area of 1 square unit, 2 square units, 1/2 square unit, 1 1/2 square unit, etc. 2) What is the largest (smallest) area you can enclose with a triangle on your board? 3) Explore similar questions in relation to other shapes. Include problems with convex and concave polygons. 4) Make as many shapes as you can which have the same area as a rectangle 2 squares by 3 squares. What happens to the shapes when you rotate the geoboard?

WEIGHT MEASUREMENT

4-65 Inventions. Purpose: Symmetry balance, problem solving

Suggested Grade Level: 1, 2

Materials needed: Building materials, such as bricks, flat boards, blocks, irregular shapes, peg boards, Primary Balancing Materials, Fulcrums, aluminum pie plates, wire clothes hangers, plasticine, etc.



Procedure: Discuss the concepts of "balance" and level. Ask children to make balances by combining any of the available materials, then compare the diverse balancing "inventions". For what can balances be used?

4-66 Balance. Purpose: Estimate, counting, graphing

Suggested Grade Level: 1, 2

Materials needed: Balance scale, common objects, clay

Procedure: Take one ball of clay. 1) Balance the clay with lima beans; 2) paper clips; 3) pebbles. Ask - 1) which is heavier?; 2) which is lighter? How many beans balance the clay, how many clips balance the clay, how many pebbles balance the clay. Have children draw pictorial representations of their findings.

4-67 Heavier Than - Lighter Than. Purpose: Comparisons, estimation, non-standard measuring units, counting equalities, inequalities, vocabulary, graphing, recording, problem solving

Suggested Grade Level: 1, 2

Materials needed: Familiar materials in children's environment to be used for weighing, pan balance scale

Procedure: What things can you find that are heavier than: a pine cone, your reader, your shoe, a fork, a spoon, a pencil, a box of crayons, 10 beads, a toy, 20 beans, a container of sand, etc. Balance and find out. Draw it. Perform similar activities with other materials and the concept "Lighter Than." Suggested recording format:

Matching Weights

4-68 Our Own Weight. Purpose: graphing, recording sets, counting, comparing, estimating, comparing, enrichment.

Suggested Grade Level: 1, 2

Materials needed: Scale, teeter-totter, graphing materials.

Procedure: Ask children to arrange themselves in a line according to estimated weight, order from lightest to heaviest. Weigh each child in the class on a school scale. Make graph to record pupils' weights. Rearrange the line according to the records. Make comparisons of the estimates and the actual weights. Let children experiment with balance, using themselves and teeter-totters.

4-69 How Many Will Balance? Purpose: Comparisons, estimation, non-standard units, equalities, inequalities, counting, recording, graphing, problem solving

Suggested Grade Level: 1, 2

Materials needed: "Junk"

Procedure: Ask, "How Many?" Milk tops balance a matchbox, draw it; counter tops balance a pencil, draw it; buttons balance a shell, draw it; beans balance 10 marbles, draw it; sea shells balance your reader, draw it; acorns balance a cup of sand, draw it. This is open ended experience and children find many interesting ways to explore further.

4-70 Even Up. Purpose: Comparison, estimation, use of non-standard measuring units, conservation

Suggested Grade Level: 1, 2

Materials needed: Balance scale, clay, materials from weighing center

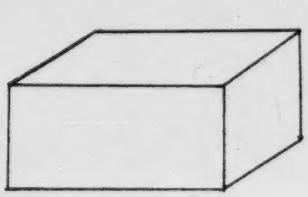
Procedure: Find 2 small things from weighing center. Hold them in your hands. Which do you think is heavier? Now put them on the balance scale. Were you right? Try some other things. Can you find 2 things that balance each other? Try to form 2 balls of clay which balance each other. Change each ball of clay into another shape. Will they still balance? Find out.

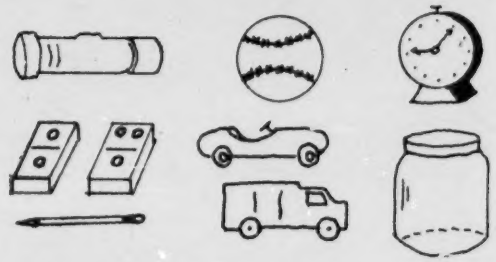
4-71 Boxed In. Purpose: Conservation, standard measuring units, estimating, comparisons, counting, pictorial representation

Suggested Grade Level: 1, 2

Materials needed: 5 different boxes, scale, junk

Procedure: Put different things into each box. 1) Guess how much each box and contents weigh; 2) Make a picture of them in order of guessed weight; 3) Weigh each box and contents; 4) Make a picture of them in order of their measured weights; 5) How good were your guesses? 6) If you inter-change the contents of boxes, will the total weights be changed? Try it!





4-72 Keeping Steady. Purpose: Conservation, comparison, estimation, equalities and inequalities

Suggested Grade Level: 1, 2

Materials needed: Clay or plasticine scales

Procedure: 1) Take a piece of clay; 2) make it round; 3) weight it; 4) make it longer; 5) weigh it; 6) break it into little pieces; 7) weight them. What did you find?

4-73 Lighter - Heavier. Purpose: Conservation, estimation, recording, equalities and inequalities

Suggested Grade Level: 2

Materials needed: Cup of water, cup of wet sand, cup of dry sand, book, eraser, clay board, bag of marbles, bag of stones, container of water, container of milk

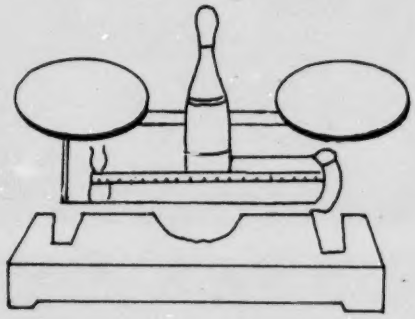
Procedure: Which is lighter? Guess. Cup of water or cup of sand? Cup of dry sand or cup of wet sand? A book or a clay board? Which is heavier? Guess. A bag of marbles or a bag of stones? An eraser or a book? A container of milk or a container of water? Weigh them. What did you find out? Draw it.

4-74 Balancing the Book. Purpose: Comparisons, estimating, experimenting with non-standard units, counting, recording, equalities and inequalities, verbalization of learning experience, problem solving

Suggested Grade Level: 1, 2

Materials needed: Junk, buttons, book, stones, marbles, pan balance scale

Procedure: How many buttons will balance a book? How many stones will balance a book? How many marbles will balance a book? Make a picture of what you find. Try other materials! See what happens. Tell the class what you learned.



4-75 Stones and Stuff. Purpose: Comparisons, estimating, experimenting with non-standard units, counting, recording, equalities and inequalities, verbalization of learning experience, problem solving

Suggested Grade Level: 1, 2

Materials needed: One stone, peas, pebbles, marbles, pan balance scale

Procedure: Put a stone on pan of the scale. How many peas weigh as much as the stone? How many pebbles weigh as much as the stone? How many marbles weigh as much as the stone? Which is heaviest? A pea, a marble, or a pebble? Which is lighest? Write down what you find.

4-76 Using Standard Weights. Purpose: Counting, recording, comparing, estimation, conservation, weighing with standard units, fractions, equalities and inequalities

Suggested Grade Level: 2, 3

Materials needed: Standardized weights, scale

Procedure: 1) Investigate assorted standard weights of 1 pound, 1/2 pound, etc.; 2) Have children heft a weight in one hand. Encourage them to find items they think are heavier (or lighter) than the held weight. Complete the experiment by actual weighings with pan balances.

4-77 "Standard Weights - One Pound". Purpose: Estimation, conservation, recording, standard units, counting sets, equalities and inequalities

Suggested Grade Level: 2, 3

Materials needed: Scales, weights, assorted objects for weighing

Procedure: 1) Think! Where do you see people using scales? 2) What things does mother buy by the pound? 3) Draw them! 4) Bring things from home that you think may weigh 1 lb. 5) Check yourself. Were you right? 6) Draw what you brought. 7) Label all the things that weighed 1 lb. 8) Compare your list with your friend's list. 9) Who found the most 1 pound articles?

4-78 One Pound, Please. Purpose: Estimation, weighing with standard units, recording

Suggested Grade Level: 1, 2

Materials needed: Pebbles, shells, sand, flour, one pound weight balance scale

Procedure: How many pebbles weigh 1 lb.? How many shells weigh 1 lb.? How many cups of sand weigh 1 lb.? How many cups of flour weigh 1 lb.? What else can you find that weighs one pound? First guess. Then weigh and find out. Record your result. Try this with a kilogram.

4-79 Pound Bags. Purpose: Weighing with standard unit, recording, comparisons

Suggested Grade Level: 1, 2

Materials needed: Balance scale, one lb. weight, pebbles, sand, marbles, bags

Procedure: Fill a bag with pebbles to make 1 lb.; fill a bag with marbles to make 1 lb.; fill a bag with sand to make 1 lb. What will balance the pebbles? Record it. What will balance the marbles? Record it. What will balance the sand? Record it. What can you find that weighs 1 lb.?

4-80 Pounding Away - 1 lb. Purpose: Counting, comparing, conservation, standard units, recording, problem solving

Suggested Grade Level: 2, 3

Materials needed: Scale, assorted items for weighing

Procedure: Can you find out - 1) How many dog biscuits weigh 1 lb.; 2) how many spools weigh 1 lb.; 3) how many sea shells weigh 1 lb.; 4) how many pebbles weigh 1 lb.; 5) how many cups of sand weigh 1 lb.; 6) how many cups of flour weigh 1 lb.; 7) how many marbles weigh 1 lb. What can you find that weighs 1 lb.? How many little bags of sand make 1 lb.? Guess. How many little bags of sugar make 1 lb.? Guess. How many little bags of flour make 1 lb.? Guess. Find out! Draw it!

4-81 Weight - Standard Units - 1 lb. Purpose: Vocabulary, comparison, estimation, standard unit, problem solving

Suggested Grade Level: 2, 3

Materials needed: Sea shells, 1 lb. weight, scales

Procedure: 1) Lift a box of sea shells. 2) Do you think that it is heavier or lighter than 1 lb.? 3) Now weigh it! 4) Were you right? 5) Try other boxes; 6) Are they heavier or lighter than 1 lb.? 7) Weigh 1 lb. of as many different things as you can; 8) What did you weigh? Write about it! Draw it!

4-82 Weight - Standard Units - 1 lb. Purpose: Counting, comparing, conservation, recording, estimating, problem solving, standard units

Suggested Grade Level: 2

Materials needed: 1 lb. weight, scales

Procedure: How many things in your classroom are heavier than 1 lb.? Draw some of them. Think! How many things that you use every day are heavier or lighter than 1 lb.? a fork? a spoon? a knife? a cup? a saucer? a pail? a milk bottle? scissors? a jug? a chair? a book? a pencil? box of crayons? bar of soap? box of cereal? make a book? Draw things that are heavier than a pound first! Then draw things that are lighter than a pound.

4-83 Little Drops of Water. Purpose: Measurement-weight, equivalent measures, addition, multiplication, fractions, sampling

Suggested Grade Level: 3, 4

Materials needed: Standard and non-standard liquid measures

Procedure: Ask children whether a gallon of water is "light" or "heavy". Pursue discussion to obtain more precise concepts of weight. Have pupils devise ways to measure the weight of a gallon of water using smaller quantities. Research: Problems involving water pressure encountered by skin divers.

4-84 Paper Weights. Purpose: Measurement, weights, estimation, whole number operations

Suggested Grade Level: 3, 4

Materials needed: Newspapers, balance scale, weights

Procedure: Children guess weight of newspaper. Check using balance and standard weights or weights children have made of plasticine. Further activities include estimating and weighing different sections of paper.

4-85 Packaging. Purpose: ounce weights, whole number addition, subtraction, fractional parts

Suggested Grade Level: 3, 4

Materials needed: Balance scale, "junk", small plastic sandwich bags, plasticine

Procedure: Have the children balance an object of known weight with counters. Now figure out how many counters are equivalent to one ounce. Plastic sandwich bags can be used for bundling one ounce packets of different objects. Children can make weights of plasticine - 1 oz., 2 oz., etc.

4-86 Weight - Standard Units (ounces). Purpose: Standard unit, estimation, weighing experience, recording

Suggested Grade Level: 3, 4

Materials needed: Scales, objects for weighing

Procedure: How many objects can you find that are lighter than an ounce, heavier than an ounce? Use the scale to check. Draw a picture of your observations.

4-87 Weight - Standard Units (ounces). Purpose: Comparisons, vocabulary, standard weight units, recording, addition

Suggested Grade Level: 3, 4

Materials needed: Balance scale, standard weights

Procedure: Check your weighing table. Ask: How many 1 oz. weights are there? How many 2 oz. weights are there? How many 4 oz. weights are there? How many oz. weights are there? Which is lighest? Which is heaviest? What weight combinations can you make with the weights you have: (Ex. 3 oz., 5 oz., etc.)

4-88 Guesstimation. Purpose: Measurement-weight; estimation

Suggested Grade Level: 3, 4

Materials needed: Scale, ordinary objects found in the classroom

Procedure: Select about 6 objects - a book, scissors, box of crayons, staples, etc. Estimate their weights, list them in order of your estimations from lightest to heaviest. Hold item and revise your estimate. Now weigh each object. Was your revised rank order correct?

Item	1st Estimate	2nd Estimate	Actual Weight
book			
scissors			
crayons			
staples			

4-89 On The Other Hand, ... Purpose: Estimation, trichotomy relations, measurement-weight

Suggested Grade Level: 3, 4

Materials needed: Balance scale, small objects, screws, fasteners, nails, beads, marbles, beans

Procedure: Children work in pairs. Put 10 screws in one hand, your friend will put 10 marbles in your other hand. Which feels heavier? Now record: "I guess 10 screws balance _____ marbles." Repeat using other objects. Now repeat using the balance scale. Were your guesses correct?

4-90 So Dense. Purpose: Measurement-weight, density, subtraction; constant volume, varying density

Suggested Grade Level: 3-6

Materials needed: Several uniformly sized jars, scales, filling substances - sand, flour, water, beans, etc.

Procedure: Pose the question, "If the jars are filled with the equal amounts but different substances," will their weights be the same or different? Why? Estimate any differences you might expect and arrange the jars in order of size from the lightest to the heaviest. Find the actual weights. What did you learn?

4-91 Who is Average? Purpose: Measurement-weight; linear measure, finding averages, graphing

Suggested Grade Level: 3-6

Materials needed: Scales, tape measures, rulers

Procedure: Make 2 graphs - one for the boys and one for the girls. Record the weight to the nearest pound of each child in the class. From the graphs guess what the average girl weighs; the average boy. Calculate the average. How good was your guess? This approach can be used for heights spans, paces, waistlines, head sizes, etc.

4-92 Selling Points. Purpose: Measurement-weight, fractions

Suggested Grade Level: 3, 4

Materials needed: Set of standard or plasticine weights, balance scale

Procedure: Using the scales and weights find the answers to the questions. 1) How many 8 oz. weights balance the pound? 2) How many 4 oz. weights balance the pound? 3) How many 2 oz. weights balance the pound? 4) How many 1 oz. weights balance the pound? 5) How many ounces in 1/2 lb., 1/4 lb., 3/4 lb.? List things sold by the pound. Some may seem strange - for example, why do you think nails are sold by the pound?

4-93 Scale Extensions. Purpose: Measurement-Weight, whole number operations, fractions

Suggested Grade Level: 3, 4

Materials Needed: Balance scale, standard or plasticine weights - 1 oz., 2 oz., 4 oz., 8 oz., 1 lb., beads, beans, marbles, screws, shells, etc.

Procedure: Find out how many marbles will balance 4 ounces. Do the same with the other objects. Make a table as follows:

How many in	1 oz.	2 oz.	4 oz.	6 oz.	8 oz.	1 lb.
Beads						
Marbles						
Beans						

Now, without doing any more weighing find out how many of each object in 1 oz., 2oz., 6 oz., 8 oz., 1 lb. Record. Use the weights to check your results.

4-94 No Hands on the Scale, Please. Purpose: Measurement-weights, whole number operations, fractions

Suggested Grade Level: 3, 4

Materials needed: 1 oz., 2 oz., 3 oz., 4 oz., 5 oz., 6 oz., 7 oz., 8 oz., standard or plasticine weights, small objects, buttons, beads, marbles, etc., balance scale

Procedure: Prepare some problems as follows: Weigh 7 oz. of marbles using the 8 oz. and 1 oz. weights; weigh 5 oz. of beans using 4 oz., 2 oz. and 1 oz. weights. Encourage children to make up similar problems for each other.

4-95 Weighing Rods. Purpose: Problem solving, graphing

Suggested Grade Level: 5, 6

Materials Needed: Cuisenaire rods, postal scale, postal rate chart

Procedure: Have students weigh a set of cuisenaire rods or any other desired items. Determine the cost of mailing the set to a city in each continent. Compare graphically the costs for mailing first class, 4th class and air mail.

TIME MEASUREMENT

4-96 "My Own Time Book". Purpose: Development of time sense

Suggested Grade Level: 1, 2

Materials needed: Drawing materials, magazines

Procedure: Have pupils draw pictures, mount photographs, or cut pictures from magazines to illustrate: a) how they looked when they were babies (Past); b) how they look now at school (Present); c) how they think they'll look when they grow up (Future); d) a family portrait with members arranged from the youngest to the oldest; e) activities performed from morning til night; f) activities performed during different seasons of the year.

4-97 Individual Clock Books. Purpose: Time measure in relationship to daily routine, telling time, counting, sequence.

Suggested Grade Level: 1, 2

Materials needed: Drawing materials

Procedure: Have each child make own picture book based on his daily sequential activities. In each picture he should draw a clock showing the time of the activity. 1) What do you do before breakfast on school days? Draw what you do. 2) What do you do in the time between breakfast and school time? Draw or write about it. 3) Draw what do we do in school before lunch? 4) When do you have lunch? Draw a lunch time picture. 5) Show what do we do after lunch in a picture. 6) When do you leave school? Do you walk home, or take the bus? Draw it. 7) When do you eat supper? Draw a supper time picture. 8) When do you go to bed? Draw it.

4-98 Make A Clock Book. Purpose: Writing numerals, counting, telling time, concept of time measurement

Suggested Grade Level: 1, 2

Materials needed: Drawing materials

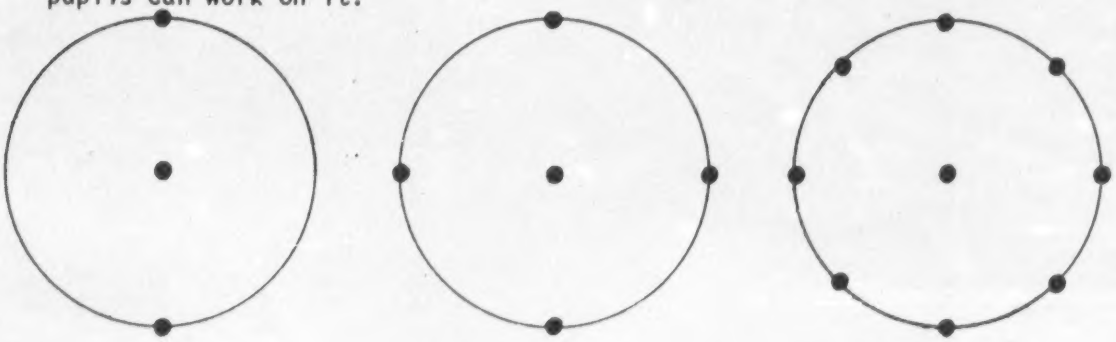
Procedure: 1) Who needs clocks? Why? 2) How many clocks do you have in your house? Draw them. 3) How many clocks are there in school? 4) How many different clocks have you seen? 5) Where do you see clocks w when you are out of doors? Draw them and show where you saw them.

4-99 "Construct A Model Clock". Purpose: Addition, subtraction, geometric shapes, special relationships, counting, writing numerals, directionality, learn to tell time, sequence.

Suggested Grade Level: 1, 2

Materials needed: Drawing materials, large graph paper

1) Teacher should draw a large circle (diameter at least 12 inches) on construction paper or oak tag. 2) Mark its center. 3) Post it so pupils can work on it.



(A) (B) (C)

4) Give directions to pupils to make marks oriented to the center: (a) straight up and then down; (b) to the right and then to the left. Put 2 equally spaced marks between each of the four marks on the circle. 5) Ask: How many marks are on the rim of the circle?" What does this marked circle remind you of? What is missing? How can we fix it? 6) Teacher now asks: If this were a clock, where would 12 go? 6? 9? etc. Children come to model and write numerals in proper places. Arms are made last and attached with fasteners. Are both arms the same length? Have children demonstrate three o'clock, six o'clock, etc. Add or subtract hours. 7) Have each child make his own model.

4-100 Individual Clock Books. Purpose: Relating sets with concept of time, graphing

Suggested Grade Level: 1, 2

Materials needed: Drawing materials

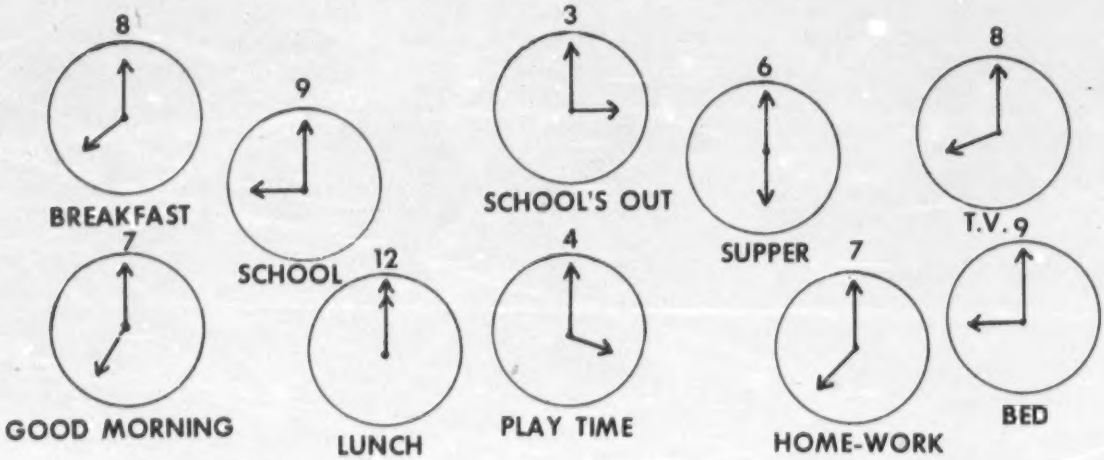
Procedure: Make books based on following questions: 1) What time do you get up? 2) Draw those who get up earlier in your house. 3) Draw those who get up later in your house. 4) Make graph of the time when each child in class gets up. 5) Draw the sets that show: a) How many get up earlier than you? b) How many get up later than you? c) How many get up same time as you? d) When do people in your house go to bed? e) Who goes to bed earlier than you? f) Who goes to bed later than you? g) Who in class goes to bed earlier than you? h) Who in class goes to bed later than you?

4-101 Make A Clock Line. Purpose: Child can consider time on a continuum, recording, calculating, problem solving, number line, angles, fractions

Suggested Grade Level: 1, 2

Materials needed: Magazines for picture cutting, drawing materials

Procedure: This activity should initially be a group activity. Eventually children will be able to make their own projects. Record pictorially in proper time sequence different activities performed during the day. Draw correct time on clock for each



Related activities: 1) Find the differences between your time line and your firend's. 2) Make a week line, a school year line.

4-102 Junior Olympics. Purpose: Time, graphing, recording, time vocabulary, inequalities

Suggested Grade Level: 1, 2

Materials needed: Watch with second hand, time clock

Procedure: use buddy system. Make sure both teams start at same time. Instructions could be: Find out who can: 1) Stand on one leg the longest? 2) Who can balance book on his head longest? 3) Balance on balancing bar longest? 4) Balance bean bag on foot longest? 5) Bounce ball longest (without missing)? 6) Get ready for gym fastest? 7) Put sneakers on fastest? 8) Is it always the same? Record it. 9) Are boys quicker than girls? 10) Ask all children at one table to write their name. Record: Who finished 1st? last? Was the one with the longest name the slowest? Was the one with the shortest name the quickest? Do long names take longer to write? 11) Which takes longer to do? Have a bath or brush your teeth? Write your name or read a story? 12) Can you think of some things that take a long time to do? A short time? What are they? These open ended activities may be developed further.

4-103 A Pendulum. Purpose: 1) Standardizing time measurement, 2) Metric System, 3) Counting

Suggested Grade Level: 1 - 4

Materials needed: Metal washer, string

Procedure: Affix a string to the edge of a shelf. At the other end, attach a metal washer. The length of the string between the shelf edge attachment and the washer should be one meter. The string will swing in 1 second beats. Count 60 swings of the pendulum, while keeping track of the second sweep on a clock.

4-104 Make A "Whizzer" String Timer. Purpose: counting, recording, time measurement, data comparisons, whole number operations

Suggested Grade Level: 1 - 2

Materials needed: String, ball of plasticine, tally counter.

Procedure: Help child tie string around ball of plasticine so as to enable him to swing it to and fro. 1) Walk down the hall with a friend. Each of you swing your whizzer gently. Count how many swings are made when you go there and when you come back. Record your data on the class graph. 2) What happens if you have a longer string? Try it. Shorter string? Try it.

4-105 Related to Travel. Purpose: Vocabulary related to time and speed, fast - slow, sets, graphing, recording, counting, addition, subtraction, time measurement

Suggested Grade Level: 1 - 2

Materials needed: Timers, picture magazines for cutting

Procedure: 1) Draw or cut out sets of things that travel fast; 2) draw or cut out sets of things that travel slowly; 3) Check your traveling pictures. How many things did you draw that go faster than you? 4) Draw a picture of an animal that could run across your classroom quickly (dog). He takes a short time. 5) Draw a picture of an animal that would cross your classroom very slowly (turtle). He takes a long time. 6) Pupils should work together using timers or counting rhythmically to obtain data. They should graph or record numerically their findings. How fast can you go across the playground? Try it. Try again, but faster. Try again, but slower. 7) Compare the time you needed to hop, skip, walk, etc. across the playground. Who was fastest? How much faster? Who was slowest? How much slower?

4-106 Time - Let's Find Out About Shadows. Purpose: Analyze awareness of sun in relation to time of day. Linear measuring, graphing, recording, time vocabulary

Suggested Grade Level: 1, 2

Materials needed: Three foot stick, tape measure or yardstick

Procedure: Make chart with class. Indicate time when measured and length of shadow. Try to start as early in the day as possible. Drive stick into ground. Measure shadow at regular intervals and record carefully. Make graph showing time and length of shadow. Questions: 1) What shape is our graph? 2) Why do you think it is this shape? 3) At what time was shadow longest? shortest? 4) How many times longer than stick was it? 5) Could be done with several sticks! Then compare results.

4-107 Timed Activities. Purpose: Time comparisons, set identification.

Suggested Grade Level:

Materials needed: "Junk"

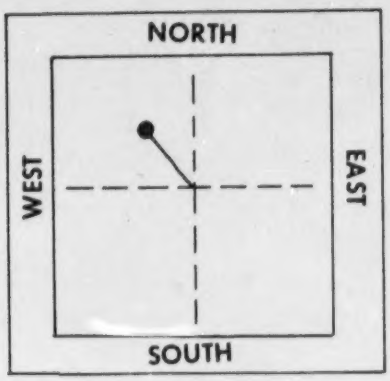
Procedure: From the "junk" pile, gather a variety of materials and several empty containers. Present tasks, (suggestions follow) to be accomplished by children from different "teams". Time their performance. Compare who was quickest, slowest, etc. 1) Find the longest ribbon. 2) Separate the white beans from the red ones. 3) Count the number of bottle caps in a pile. 4) Find something heavier than a bead.

4-108 Make a Sundial. Purpose: Time measurement, shadows, directionality, recreation of a time device used long ago

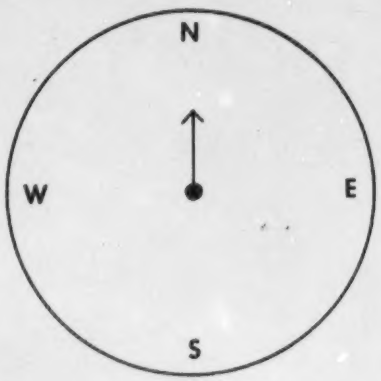
Suggested Grade Level: 3 - 6

Materials needed: Large board, unruled paper, three inch nail, compass, marker

Procedure: 1) Attach paper to board. Draw the horizontal and vertical mid-lines of the paper. Write North, East, South, West at the end of the mid-lines. 2) Hammer 3-inch nail at the intersection of the mid-lines. 3) Outdoors, use compass to locate "North" and place board in position to correspond with the compass. 4) Every hour, have children help mark length of the nails shadow. Join all the marks. 5) Experiment with children each nice day by putting board out in same place and see whether they can tell time using the sundial.



SUNDIAL BOARD



COMPASS

4-109 "Minute Minding". Purpose: Measurement - Time

Suggested Grade Level: 3, 4

Materials needed: Prepare ditto sheets or assignment card as below

Procedure: Children work in pairs - one timing the other for one minute. Use clock or timer. When one child says "Now", other begins and works for one minute until timer says "Stop". 1) Counting by 2's, 3's, 5's, write as many numbers as you can. 2) Write as many 3 letter words as you can. 3) Put a stroke on the paper every time you breathe in. Children can think of many other things to do. Most children will be surprised at how much can be done in one minute.

4-110 Make A Sand Timer. Purpose: Time concepts developed, time measurement

Suggested Grade Level: 3, 4

Materials needed: Two bottles, sand, plasticine, paper and tape

Procedure: Put sand in one bottle. Tape piece of paper with small hole in center over it. Put open end of second bottle exactly over first. Hold necks of bottles together with wide strip of plasticine. Make certain that sand runs smoothly through hole from one bottle to the other. Have children work in pairs - one doing, the other observing. 1. Try to write your name before the sand runs out. Did you have time left? 2. Count the girls in class or boys in class. Did the sand run out? 3. Find 4 round things or square or anything you decide. Did the sand run out? Record answers each time. 4. Set the timer! Did the sand run out, on the following?: Sharpen a pencil, take off shoes and socks, tie your shoelace, thread 20 round beads. 5. How many beads can you thread before the sand runs out? 6? Write numberals in order staring with 0 and going as far as you can. What were you writing when the sand ran out?

4-111 The Shadow Goes. Purpose: Measurement - Time and Shadows

Suggested Grade Level: 3, 4

Materials needed: A stick about 3 or 4 feet long, tape measure, graph materials

Procedure: This activity should be done on a clear, sunny day. Choose an open space and set stick upright in the ground. Beginning early in the day at half hour intervals, send 2 children out to measure the length of the stick's shadow. Children keep a record as follows:

Time	8:30	9:00	---
Length of shadow			

Next day prepare a graph based on findings. Children can discover much interesting information, i.e. what shape is the graph? Why do you think it is this shape? When was the shadow shortest? Longest?

4-112 Make A Water Timer. Purpose: Time concepts developed, time measurement

Suggested Grade Level: 3-5

Materials needed: Large pan of water. Small tins (example: tuna can) plus others, hammer and nail

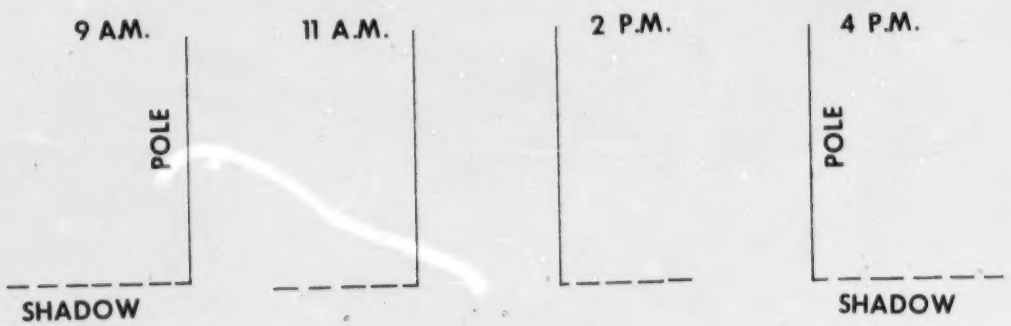
Procedure: Have each child who participates made small hole in bottom of can with nail and hammer. Ask children in group to float cans. Watch! What happened? Did all sink at same time? Suggestion! If there is difficulty with can sinking, put piece of plasticine on bottom of can to help. Set water timer! Did you beat the timer on following: Find 4 things shorter than ____ . Untie shoelaces and tie them. Roll ball across the room and back. Hop on one foot across the room and back. Look at clock in classroom. How long did it take for the water timer to sink? Encourage pupils to devise further activities.

4-113 Shadow Sticks. Purpose: Fractional addition, linear measure, estimation, patterns, data analysis

Suggested Grade Level: 5, 6

Materials needed: Sticks - 1, 2, 3, 4, 6 feet in length, graph materials

Procedure: Once a month, on a sunny day, have teams of students work outdoors on the following experiment. Data should be collected at 10 a.m., noon, and 2 p. m. Children should arrange their information in graphic form. 1) Have a student hold a one foot stick vertically on the ground while his partner measures the length of its shadow. 2) Repeat this for a 2 foot stick and a 3 foot stick. 3) Consider - a) Can you guess the length of the shadow for a 4 foot stick? 6 foot? Check your guess; b) Did the shadows change in a consistent way? during the day? from month to month? c) How could your experiment results be used?



MEASUREMENT

Selective Manipulative Materials for Math Lab Use

Measurement: Many of the materials used in developing math lab experiences within the three other major sections of this series of publications may also be used for measurement activities.

Improvised materials: Bank books, coins and bills, graphs from newspapers and social studies textbooks, invoices from local businesses, lattices, mailorder catalogs, Napiers rods, nomographs, restaurant menus, score cards, slide rule made from ordinary rulers and yardsticks, spinners and dice, supermarket price lists, baseball batting averages and other sports data, ecological problem studies, egg cartons, industrial and fine arts and home economics project involving measurement, time tables, also, acorns, beans, bottle caps, buttons, classroom equipment (books, erasers, pencils, window panes, desks, chairs, floor tiles, etc.), corks, discs, fingers, foot and handprints, graph paper, horse chestnuts (conkers), ice cream sticks, leaves, money, number lines, pebbles, pine cones, sample swatches of various materials, seasonal paper cut-outs (pumpkins, snowmen, hearts) seeds, shells, straws, telephone directories, tiles, toothpicks, twigs, also, the body used for measuring (thumb, foot, cubit, pace, etc.), boxes, cartons and other containers, geo-strips, hat and shoe size charts, machine shop decimal conversion table, paper patterns for solids, polyominoes, postal rates chart, road maps, time tables, and "treasure" hunts related to coordinate grids.

Improvised Games:

Bingo
Pebbles in the Bag
Postman Stories
What's My Rule
Hopscotch
Buzz
Tower Puzzle
Tangrams
Dot to Dot

Commercial Materials: Almanac data, assorted measurement tools, equalizer, flash cards, balance, lattice number boards, Napier bones, number lines and tracks, spring and pan balance scales, also abaci and counting frames, attribute blocks, beads, binary counter blocks, clay or plasticine, calendars, clocks and other timers, clothespins, cubes, dials, directed number slide rule, discs, dice, dominoes, felt shapes and flannel board, fundamath, geoblocks, geoboards, magnetic shapes, mechanical and/or electronic desk calculators, metal washers, meters, number lines, playing cards, pop-it beads, small toys (animals, vehicles, dolls, marbles, checkers, etc.) slide rules, squared materials, structural materials, centimeter rods, Stern material, unifix rods, multibase arithmetic blocks, stencil graph, tally registers, tongue depressors, trundle wheels.

Commercial Games: Quizmo, Tiddly-Winks, Monopoly, Yahtzee, Countdown, The Real Numbers Game, Back-Up Three, Numble, Assorted Score Keeping Games, Bingo, Make Ten, Quinto, Three Dimensional Tic-Tac-Toe, The Winning Touch, Ring Toss, Make 1, Fractions, Dominoes, Hexstat, and many others.

General Supplies:

Paper - ruled, unruled
graph - squares (1/10", 1/4", 1/2", 1"), isometric
gummed shapes
construction, art, newsprint, tracing
brown wrapping, wallpaper, carbon
library card - 3" x 5", 5" x 8"
corrugated cardboard

Thumb tacks, paper fasteners, clips pins, cellophane and masking tape, glue, paste, scissors, strings, rubber bands, sponges, laces, yarn, straw, pipe cleaners, plasticine or clay, pencils, paints, brushes, crayons, stapler, stamp pads, filing folders, tool chest, balsa wood, screws, nails, styrofoam forms.

Storage Containers: 1) Cardboard boxes, rectangular and cylindrical (covered with vinyl wallpaper for strength and color): 2) baskets, crates, and bushels from the produce markets; 3) wire hangers and clothespins or clamps for display and paper storage; 4) emptied aluminum, tin, cardboard, plastic food containers - checked for sharp edges and then painted; 5) commercial containers.

Abaci and Counting Frames: These instruments are the ancient forerunners of modern computers. Sliding counting beads may be strung on wire or laces, or placed loosely on a patterned, place value board. A large assortment of excellent commercial models are available. However, they are easy and fun to make. Number bases other than ten can be represented on abaci.

Binary Counter: Mechanical or electrical devices that can display binary numeration. The mechanical counters show combinations with the symbols 0 and 1, while the electrical ones are coded with on-off switches for display lights. Intermediate grade pupils may be challenged to build binary counters.

Dominoes: Many variations on traditional dominoes are now available for teaching concepts of matching, counting, arithmetic operations, and geometric discrimination.

Hundred Chart: Felt on paper chart, can be used on flannel board or tacked up on cork board. This device can be used for skip counting, number patterns, and whole number operations.

Number Lines: A great variety of number lines have been commercially prepared. You can choose ordinary measuring rulers, plastic walk-on number line "carpets", graduated measuring cups, baby bottles, etc... There are perforated rolls of number lines which adhere to desks or shelves. Felt, wood, and plastic number lines are also available. Fractional numbers and directed numbers have been prepared in the form of number lines.

Squared Materials: Cardboard sets consist of single units, strips of ten, and blocks of 100. They may be used to reinforce place value concepts, as concrete representations of numbers, and for addition and subtraction of numbers with and without exchange. Comparable procedures may be developed with graph paper.

Stencil Graphs (Lattices): Perforated plastic sheets come on a window shade roller. The device is hung over a chalk board. The shade is pulled down and rubbed with an ordinary chalking eraser. The shade is then lifted and a chalked lattice is available for further marking.

Structural Materials: a) Centimeter Rods - Colored, graduated rectangular centimeter rods serve as a model of the rational number system. Supportive materials - teachers' Manuals, films, activity cards, and pupils' work books - suggest mathematical concepts to be discovered by using the rods (Patterns, Whole Number and Fractional Operations, Trichotomy, Set and Special Relations).

b) The Montessori Rods are enlarged versions of the centimeter rods.

c) Stern Materials - Colored, graduated rectangular rods, pattern boards, number track, nesting trays. Teachers' kindergarten manual is very helpful in program development.

d) Unifix Materials - Colored, interlocking, plastic "cubes" may be used as items a-c (above) and for concepts of conservation, balance, graphing, patterning, and multi-base representation. Coordinated trays and boards are available. The Stern and Unifix supplementary materials are based on a three-quarter inch module.

ADDITIONAL MATERIALS

PRINTED BY THE UNIVERSITY OF THE STATE OF NEW YORK PRESS

47025